IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of	Atty. Docket
STEFAN M.J. WILLEMS	PHBE 020033
Serial No.: 10/534,316	Group Art Unit: 2615
Filed: May 9, 2005	Examiner: Ping Lee

METHOD AND APPARATUS FOR GENERATING AUDIO COMPONENTS

Commissioner for Patents
P.O. Box 1450
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Sir:

APPEAL BRIEF

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(i) <u>Real Party in Interest</u>

The real party in interest in this application is KONINKLIJKE PHILIPS ELECTRONICS N.V. by virtue of an assignment from the inventor recorded on May 9, 2005, at Reel 017311, Frames 0050.

(ii) Related Appeals and Interferences

There are no other appeals and/or interferences related to this application.

(iii) Status of Claims

Claims 1, 4-6 and 8 stand finally rejected by the Examiner, Claim 3 has been allowed, and Claims 2 and 7 have been cancelled.

The rejection of claims 1, 4-6 and 8 is being hereby appealed.

(iv) Status of Amendments

There was one Amendment filed on April 19, 2007, after final rejection of the claims on March 12, 2007, this Amendment having been entered by the Examiner.

(v) <u>Summary Of Claimed Subject Matter</u>

The subject invention relates to a method and apparatus for generating an output audio signal by adding output components in a predetermined first frequency range to an input signal, the output components being generated by performing a predetermined calculation. In particular, the subject invention relates to generating high frequency output components by applying, for example, a squaring function to first components in an input signal, e.g., when decompressing a compressed audio signal, like MP3 audio. However, the output audio signal sounds unnatural since the energy of the output components is directly determined by the energy of the squared input components, and hence is not what is to be expected for high frequency components in a natural sound.

An object of the invention is to provide a method and apparatus which yields an output audio signal which sounds relatively natural.

Such a method is claimed in claim 1 which includes "generating an output audio signal by adding output components in a predetermined first frequency range to an input signal, the output components being generated by performing a predetermined calculation on first input components in a predetermined second frequency range". This is shown in Figs. 1a and 1b, and described in the specification on page 4, lines 27-29, in which an input audio signal 100 includes first input components 102 in a second frequency range R2, second input components 104 in a third frequency range R3, and third input components 103 in a fourth

frequency range R4, the frequency ranges R2-R4 being included in a quality frequency range O. As described on page 5, lines 32-34, an output audio signal "contains original components 122, which are substantially identical to the components 102, 103, 103 in the quality frequency range O of the input audio signal 100." The output audio signal also includes output components 125 is generated based the first input components 102 in the second frequency range R2 by performing a non-linear function, e.g., squaring (page 6, lines 8-19. Claim 1 further includes "a first output energy measure, over a predetermined first time interval, of the output components generated is set, based upon a first input energy measure calculated over a predetermined second time interval of second input components, in a predetermined third frequency range of the input audio signal, wherein the predetermined third frequency range is different from the predetermined second frequency range, and is selected from a predetermined number of frequency ranges, as the frequency range which is closest to the first frequency range according to a predetermined frequency range distance formula". As shown in Fig. 3 and described in the specification on page 7, lines 4-12, a first input energy measure E1 is calculated for he second input components 104 over a second predetermined time interval dt2. Then, at lines 22-25, it is stated "From the first inp0ut energy measure E1, a first output energy measure S1 over a predetermined first time interval dt1 is derived. In a simple embodiment, the first time interval dt1 equals the second time interval dt2, and the first output energy measure S1

equals the first input energy measure E1." Further, the determination of the third frequency range is described in the specification on page 8, lines 6-10 and lines 16-25.

Claim 5 claims an "apparatus for generating an output audio signal by adding output components in a predetermined first frequency range to an input audio signal" This is shown in Fig. 5, and described in the specification on page 10, lines 26-29, where the output components 125 ... are added by an adder 519 to the quality components of the input signal 100."

In addition, the claim 5 apparatus includes "calculation means for calculating the output components from first input components in a predetermined second frequency range of the input audio signal". This is shown in Figs. 2 and 5, and described in the specification on page 6, lines 8-19, in which calculation 200 generates the output components 125 by performing a non-linear function to first input components 102 in a predetermined second frequency range R2. Alternatively, as described in the specification on page 9, line 18 to page 10, line 5, bandpass filters 501/502/503 isolate first input components 102 in a predetermined second frequency range R2 of the input audio signal 100, while non-linear circuits 506/507/508 apply non-linear functions to the outputs of the bandpass filters 501/502/503.

The invention, as claimed in claim 5 further includes "filtering means obtaining second input components in a third frequency range of the input audio signal". This is shown in Fig. 5, and described in the specification on page 10, lines 5-6 in

which "Filter 590 generates a band limited signal corresponding to the second input components, e.g. as a band pass filter".

In addition, the invention includes "energy calculation means for obtaining a first input energy measure over a second predetermined time interval of the second input components and deriving therefrom a first output energy measure". This is shown in Fig. 5, and described in the specification on page 10, lines 5-17, in which the output of bandpass filter 590 is applied to a first energy-measuring unit 521 to measure the first input energy measure E1, while an output energy specification unit 520 determines a first output energy measure.

Furthermore, the claim 5 apparatus includes "energy setting means for setting the energy of the output components over a first predetermined time interval substantially equal to the first output energy measure". This is shown in Fig. 5, and described in the specification on page 10, lines 21-25, in which energy setting units 515/516/517 set the energy of output component 125 (and 126) in response to the first output energy measure.

Finally, the apparatus of claim 5 includes the limitation "wherein the predetermined third frequency range is different from the predetermined second frequency range, and is selected from a predetermined number of frequency ranges, as the frequency range which is closest to the first frequency range according to a predetermined frequency range distance formula". This determination of the third frequency range is described in the specification on page 8, lines 6-10 and lines 16-25.

The invention further relates to an audio player including the apparatus of claim 5. In particular, claim 6 claims an audio player which includes "audio data input means for providing an input audio signal". This is shown in Fig. 6, and described in the specification on page 10, line 34 to page 11, line 2.

The audio player further includes "an apparatus for generating an output audio signal as claimed in claim 5". This is indicated in the specification on page 10, lines 30-31.

Finally, the audio player includes "signal output means for receiving the output audio signal from said apparatus". This is described in the specification on page 11, lines 2-4.

(vi) Grounds of Rejection to be Reviewed on Appeal

(A) Whether the invention, as claimed in claims 1, 4-6 and 8, is unpatentable, under 35 U.S.C. 103(a), over U.S. Patent 6,111,960 to Aarts et al. in view of U.S. Patent Application Publication No. 2003/0009327A1 to Nilsson et al.

(vii) <u>Arguments</u>

<u>(A) The 35 U.S.C. 103(a) Rejection Of Claims 1, 4-6, 8</u>

35 U.S.C. 103(a) states:

> "(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made."

The Aarts et al. patent discloses circuit, audio system and method for processing signals, and a harmonics generator, in which high frequency output components are generated by applying e.g., a squaring function to first components in the input signal. For example, if output components are desired in a first frequency range between 10 and 12kHz, they can be generated by the squaring function which doubles the frequency of first components in a predetermined second frequency range between 5 and 6kHz. This is useful, e.g., when the input audio signal is obtained by decompressing compressed audio like MP3 audio, in which no high frequency information is present. The lack of high frequency components results in that the audio sounds unnatural. The squaring function is a technically simple way to generate high frequency audio components.

Appellant concedes the relevance of Aarts et al., Aarts et al. having been cited in the specification of the subject invention as being prior art. However, as acknowledged by the Examiner, Aarts et

al. "fails to show that a first output energy measure, over a predetermined first time interval, of the output components generated is set, based upon a first input energy measure calculated over a predetermined second time interval of second input components, in a predetermined third frequency range of the input audio signal, wherein the predetermined third frequency range is different from the predetermined second frequency range, and is selected from a predetermined number of frequency ranges, as the frequency range which is closest to the first frequency range according to a predetermined frequency range distance formula."

The Nilsson et al. patent discloses bandwidth extension of acoustic signals in which a narrow-band acoustic signal is fed to a feature extraction unit 101, an up-scaler 102 and an excitation expansion unit 105, each having associated circuitry for processing the narrow band acoustic signal in order to improve the perceived sound quality of a decoded acoustic signal. The improvement is accomplished by means of extending the spectrum of the received acoustic signal.

The Examiner now states:

> "Nilsson teaches the importance of adjusting the energy (by 106) of the output components (from 105) to make a more natural wideband sound (para. 0055) when expanding the bandwidth of the original sound source in a narrow bandwidth. The energy in high band (corresponding to the claimed "third frequency range") is being used to determine the envelope of the output components (corresponding to the claimed "a first output energy measure") to be added with the original audio source signal (para. 0040, 0046, 0054). As shown in Fig. 4, the high band is closest to the first frequency range according to a predetermined frequency range distance formula (para. 0033)."

Appellant submits that the Examiner is mistaken. While an object of Nilsson et al. is to improve the perceived sound quality of a decoded acoustic signal, Nilsson et al. does not perform that which is claimed in either claim 1 or claim 5. In particular, according to the Examiner, the energy in high band (corresponding to the claimed "third frequency range") is being used to determine the envelope of the output components. However, Appellant would like to point out that the high band of Nilsson et al. is the added frequency range, while the third frequency range of the subject invention lies within the input audio signal, which Nilsson et al. refers to as the narrow-band signal.

It should be noted that while Nilsson et al. makes mention of "narrow-band", Nilsson et al. is referring to the entire spectrum W_{NB} of the received narrow-band signal a_{NB}. Similarly, "high-band" refers to the added frequency components in the spectrum W_{HB}. As such, the energy-ratio estimator 104a of Nilsson et al. uses the energy in the entire narrow-band, that is, all of the received narrow-band signal a_{NB} in order to estimate the ratio.

As specifically stated by Nilsson et al. in paragraph [0054]:

> "The energy-ratio estimator 104a, which is included in the wide-band envelope estimator 104, receives the first component c_0 in the vector of linear frequency cepstral coefficients c and produces, on basis thereof, plus on basis of the narrow-band shape x and the degree of voicing r an estimated energy-ratio between the high-band and the narrow-band."

As such, the energy-ratio estimator 104a **estimates** an energy ratio between the high-band (W_{HB}) and the narrow-band (a_{NB}) based on the

first component c_0 (c_0 constitutes the log energy of the narrow-band acoustic segments s (paragraph [0053])), the narrow-band shape x and the degree of voicing r. If the high-band corresponded to the claimed third frequency range, then there would be no need for an estimate, in that the third frequency range is within the frequency range of the input audio signal and as such, the energy therein is known. Rather, the energy-ratio estimator 104a needs to estimate the ratio in that the energy in the high-band, which is the band W_{HB} added to the input audio signal A_{NB} having a bandwidth W_{NB}, is not known, and is to be established.

The subject invention determines the output components in a first frequency range (e.g., above the frequency range of the input audio signal) to be added to the input audio signal, from components in a second frequency range of the input audio signal (e.g., a low frequency range of the input audio signal), and sets a first output energy measure of the output components based on a first input energy measure in a third frequency range of the input audio signal (e.g., a high frequency range of the input audio signal).

Appellant submits that if one were to use the analogy of Nilsson et al., then the output components in the first frequency range are generated by the component 105 of Fig. 1, while the first output energy measure is adjusted by component 106. Hence, the input to block 106 must be the first input energy measure which is in a third frequency range of the input audio signal. Block 101 is described in Nilsson et al. at paragraphs [0034] and [0035] as a

feature extraction unit 101. Such a feature extraction unit 101 is then described in paragraphs [0047] - [0070]. However, nowhere is there any disclosure or suggestion of determining a third predetermined frequency range, wherein the predetermined third frequency range is different from the predetermined second frequency range (i.e., the frequency range of the input audio signal used to determine the output components), and is selected from a predetermined number of frequency ranges, as the frequency range which is closest to the first frequency range according to a predetermined frequency range distance formula.

The Examiner now states "the high band energy used in Nilsson is the high band as shown in Fig. 3. Fig. 3 shows the original narrow band input signal."

As noted in paragraph [0026] of Nilsson et al., "FIG. 3 exemplifies a spectrum of the acoustic source signal in FIG. 2 after having been passed through a narrow-band channel". However, also shown in Fig. 3 is a frequency band f_1 - f_2, and the labels E_{NB} and E_{WB} appearing next to phantom markings. It appears that the Examiner is assuming that this means that the energy in this frequency range is being used by energy-ratio estimator 104a/wide-band filter 106 to set the energy level in the high-band.

However, Appellant stresses that the Examiner's assumption is incorrect. In particular, an explanation of f_1, f_2, E_{NB} and E_{WB} is given in Nilsson et al. at paragraphs [0073]-[0074], where the excitation extension unit 105 uses this frequency band of the narrow-band signal A_{NB} to form the high-band W_{HB} as shown in Fig. 4

(by successive up-folding). Hence, the frequency band f_1 - f_2 would correspond to the second frequency range in the claims of the present invention. Nowhere in Nilsson et al. is it shown or suggested that the energy of the frequency band f_1 - f_2 should be used, e.g., by the energy-ratio estimator 104a, to determine the energy in the high-band portion. Further, claim 1 specifically states that "the predetermined third frequency range is different from the predetermined second frequency range".

The Examiner also states "As shown in Fig. 4, the high band is closest to the first frequency range according to a predetermined frequency range distance formula (para. 0033)."

Paragraph [0033] states:

> "FIG. 1 shows a block diagram over a general signal decoder according to the invention, which aims at producing a wide-band acoustic signal a_{WB} on basis of a received narrow-band signal a_{NB}, such that the wide-band acoustic signal a_{WB} perceptually resembles an estimated acoustic source signal a_{source} as much as possible. It is here presumed that the acoustic source signal a_{source} has a spectrum A_{source}, which is at least as wide as the bandwidth W_{WB} of the wide-band acoustic signal a_{WB} and that the wide-band acoustic signal a_{WB} has a wider spectrum a_{WB} than the spectrum a_{NB} of the narrow-band acoustic signal a_{NB}, which has been transported via a narrow-band channel that has a bandwidth W_{NB}. These relationships are illustrated in the FIGS. 2-4. Moreover, the bandwidth W_{WB} may be sub-divided into a low-band W_{LB} including frequency components between a low-most bandwidth limit f_{WI} below a lower bandwidth limit f_{NI} of the narrow-band channel and the lower bandwidth limit f_{NI} respective a high-band W_{HB} including frequency components between an upper-most bandwidth limit f_{Wu} above an upper bandwidth limit f_{Nu} of the narrow-band channel and the upper bandwidth limit f_{Nu}."

Appellant submits that it should be clear that this paragraph of Nilsson et al. neither discloses nor suggests the claim limitation, that the predetermined third frequency range "is selected from a predetermined number of frequency ranges, as the frequency range which is closest to the first frequency range according to a predetermined frequency range distance formula".

Based on the above arguments, Appellant believes that the subject invention is not rendered obvious by the prior art and is patentable thereover. Therefore, Appellant respectfully requests that this Board reverse the decisions of the Examiner and allow this application to pass on to issue.

Respectfully submitted,

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(viii) Claims Appendix

1. (Previously Presented) A method of generating an output audio signal by adding output components in a predetermined first frequency range to an input signal, the output components being generated by performing a predetermined calculation on first input components in a predetermined second frequency range, characterized in that a first output energy measure, over a predetermined first time interval, of the output components generated is set, based upon a first input energy measure calculated over a predetermined second time interval of second input components, in a predetermined third frequency range of the input audio signal, wherein the predetermined third frequency range is different from the predetermined second frequency range, and is selected from a predetermined number of frequency ranges, as the frequency range which is closest to the first frequency range according to a predetermined frequency range distance formula.

4. (Previously Presented) The method as claimed in claim 1, wherein the predetermined calculation comprises applying a non linear function to first input components in a predetermined second frequency range of an input audio signal.

5. (Previously Presented) An apparatus for generating an output audio signal by adding output components in a predetermined first

frequency range to an input audio signal, said apparatus comprising:

calculation means for calculating the output components from first input components in a predetermined second frequency range of the input audio signal;

filtering means obtaining second input components in a third frequency range of the input audio signal;

energy calculation means for obtaining a first input energy measure over a second predetermined time interval of the second input components and deriving therefrom a first output energy measure; and

energy setting means for setting the energy of the output components over a first predetermined time interval substantially equal to the first output energy measure,

wherein the predetermined third frequency range is different from the predetermined second frequency range, and is selected from a predetermined number of frequency ranges, as the frequency range which is closest to the first frequency range according to a predetermined frequency range distance formula.

6. (Previously Presented) An audio player comprising:

audio data input means for providing an input audio signal;

an apparatus for generating an output audio signal as claimed in claim 5; and

signal output means for receiving the output audio signal from said apparatus.

8. (Previously Presented) A data carrier storing a computer program for execution by a processor, the computer program causing the processor to execute the method as claimed in claim 1.

(ix) Evidence Appendix

There is no evidence which had been submitted under 37 C.F.R. 1.130, 1.131 or 1.132, or any other evidence entered by the Examiner and relied upon by Appellant in this Appeal.

(x) Related Proceedings Appendix

Since there were no proceedings identified in section (ii) herein, there are no decisions rendered by a court or the Board in any proceeding identified pursuant to paragraph (c)(1)(ii) of 37 C.F.R. 41.37.